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A GUIDE TO THE IDENTIFICATION OF MEXICAN SPHAGNA

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Sphagnum is a minor element in the Mexican moss flora. Only ten species have been found in the country, only one of them endemic. Phytogeographic probabilities are that at least half a dozen others of broad distribution and nearby occurrence can be expected to occur there. It is reasonable to expect some additional species to show up as disjuncts from the Coastal Plain of southeastern United States, possibly from the Southern Appalachian Mountains, and a few others from Antillean and Andean floras. The moss flora of Mexico is incompletely known, and the *Sphagnum* flora especially needs careful attention. Few bryologists have collected intensively in Mexico, and still fewer have known *Sphagnum* well enough to collect with discrimination.

The genus is taxonomically difficult, yet with basic understanding and some experience one can recognize most species with ease, owing to fairly obvious differences in size, color, and form, as well as habitat preference. A readable explanation of the characters useful in taxonomy is to be found in Blomquist's illustrated account of the peatmosses of the southeastern United States (Jour. Elisha Mitchell Sci. Soc. 54: 1–21. 1938). The microscopic characters basic to critical determination are best observed on staining. Any water-soluble stain can be used. A saturated solution of Gentian (or Crystal) Violet gives especially good contrast.

Andrews' revision of the North American *Sphagna,* published in the *North American Flora* in 1913, includes most of the species known from Mexico. His keys and descriptions are excellent, but his concept of species is cautious and conservative to a fault. Warnstorf's *Sphagnologia Universalis,* published in *Das Pflanzenreich* in 1911, is also useful, even though species are narrowly defined. Rigid definitions of species are scarcely possible, or desirable, but further study of the tropical *Sphagna* should result in a more meaningful taxonomy than Andrews' lumping and Warnstorf's splitting have offered.

The unique features of the peatmosses justify treatment at the level of class, as the Sphagnopsida. The class consists of a single genus, *Sphagnum* L., and something less than 200 species. The genus is especially well represented in the North, in glaciated areas of impeded drainage. Many of the species of broad northern distribution range disjunctively southward into the tropical highlands, but a good many species are completely tropical in range. It is curious that the majority of the *Sphagna* of Mexico, tropical in position, are disjuncts from the North.

The following treatment is based on an accumulation of Mexican records in various North American herbaria noted over a period of 30 years and more, especially in the herbaria of the University of Michigan, University of Tennessee, New York Botanical Garden, U. S. National Museum, and Field Museum. Because this is intended as an aid in identification rather than a scholarly monograph, little attempt is made to cite specimens and precise localities. Collections have been too spotty and too incomplete to make such citations meaningful. Habitat information, gleaned from Mexican specimens, is presented with apology as it is scarcely informative as to ecological preferences or requirements and scarcely useful in evaluating species as ecologically meaningful taxa.

SPHAGNUM L.

Slender to moderately robust mosses of wet habitats, sometimes submerged but more often growing above water level in carpets, cushions, or hummocks. Protonema a small, flat thallus producing 1 or rarely 2 leafy gametophores, proliferating secondary thalli at the ends of filamentous outgrowths from the margins; rhizoids few, at base of the gametophore (and lacking after early stages of growth), with oblique cross walls. Stems of indeterminate apical growth, erect (or in aquatic species weak and spreading), repeatedly forked, consisting of a central core of thin-walled parenchyma enveloped by a pigmented wood cylinder (scleroderm) of thick-walled prosenchyma which is surrounded by a cortex (hyaloderm) of 1 or more layers of large, empty, hyaline, thin-walled cells which are sometimes spirally fibrillose and, if so, usually porose on the outer surface, or efibrillose and generally lacking pores. Branches determinate in growth, in fascicles spirally disposed around the stem and crowded at the stem tip in a head-like tuft (capitulum), some branches spreading and others, of more slender construction, pendent and often corticating the stem. Branch cortex usually in 1 layer, consisting of large, empty, hyaline cells which may be spirally fibrillose and generally porose or lacking fibrils with some cells differentiated as retort cells, larger and porose at the tip of a short, protruding neck, rarely all cells uniform and porose. Branch leaves spirally inserted in a 2/5 phyllotaxy, consisting of linear green cells (chlorocysts) in a network enclosing large, empty, hyaline, rhomboidal cells (hyalocysts) reinforced within by annular fibrils and perforated by rounded to elliptic pores on 1 or both surfaces (or very rarely lacking fibrils and/or pores), commonly bordered by about 2–3 rows of linear cells, sometimes by 1 row of elongate cells apparently digested away at the outer margin as a resorption furrow. Stem leaves less crowded, usually differentiated in size and shape, the hyaline cells sometimes subdivided, typically with a lesser development of pores and fibrils, often extensively resorbed on 1 or both surfaces resulting in a wrinkling as membrane pleats or in rounded thin spots or large, irregular membrane gaps. Dioicous or monoicous; antheridial branches catkin-like, with leaves not much differentiated but commonly crowded and often highly colored, single or in fascicles of 2–3, the antheridia globose, long-stalked, borne singly at the side of each leaf of the catkin; perichaetial branches short, 1–2 or more per fascicle, bearing at the apex 1–5 narrowly flask-shaped archegonia, the perichaetial leaves large, broadly lingulate, sheathing the sporophyte until its maturity. Sporophyte consisting of a sessile capsule and a massive foot embedded in the tip of the perichaetial branch which elongates as a pseudopodium to elevate the mature capsule beyond the perichaetium; capsules globose, becoming cylindric to urceolate when dry and empty, reddish to dark-brown or black, without annulus or peristome; operculum flat or nearly so; wall of several layers of cells, without intercellular spaces, usually, in the lower half of the urn or nearly throughout, with a large number of somewhat sunken pseudostomata (consisting of paired guard cells but no pore); endothecium giving rise to a dome-like columella surrounded and overarched by sporogenous tissue derived from the inner layer of the amphithecium (and from the endothecium where the sporogenous tissue overarches the columella). Spores large (ca. 18–42 μm), tetrahedral, triradiate-ridged, nearly smooth to finely papillose-roughened, explosively discharged as the capsule shrinks on drying. Calyptra a very delicate, hyaline membrane becoming irregularly ruptured at maturity of the capsule.

1. Branches club-shaped, with cortical cells nestled together because of funnel-like bases. 3. *S. portoricense*

1. Branches not club-shaped, with cortical cells plane at base.
   2. Branches stout and tumid, with cortical cells spirally fibrillose; branch leaves broadly ovate to suborbicular, cucullate-concave at a broadly obtuse apex, roughened at back of the apex and denticulate-bordered because of resorption.

3. Plants normally reddish; cells of stem cortex with 1 or sometimes 2–4 pores on the outer surface; green cells of branch leaves in section elliptic, central, and entirely included. 1. *S. magellanicum*
3. Plants pale-green, yellowish, or yellow-brown; cells of stem cortex normally with numerous pores, (1)2–7(11); green cells of branch leaves in section narrowly triangular, with the base exposed on the inner surface. 2. *S. palustre*

2. Branches slender; cortical cells lacking fibrils; branch leaves narrower, generally oblong-ovate to lanceolate, concave but not cucullate, narrowly to broadly truncate, not roughened at back of the apex, with 1–3 or more rows of linear cells at the margins and generally entire (or, in *S. strictum,* denticulate-bordered because of marginal resorption).
4. Cortical cells of branches uniform, uniporose at upper ends; stem leaves much smaller than branch leaves; branch leaves concave but not usually involute-tapered, broadly truncate, denticulate-bordered by a resorption furrow. 4. *S. strictum*
4. Cortical cells of branches of 2 kinds, some large and porose at their protruding upper ends, others smaller and lacking pores; stem leaves generally half as long as the branch leaves or longer; branch leaves (at least when moist) involute-tapered to a narrowly truncate tip, bordered by linear cells in 2 or more rows, entire, without a marginal resorption furrow.
5. Branch leaves abruptly narrowed from a broad erect base to a squarrose limb; hyaline cells of branch leaves usually faintly papillose on inner surfaces adjacent to green cells. 5. *S. squarrosum*
5. Branch leaves gradually tapered, sometimes spreading to the tips when dry but scarcely squarrose; hyaline cells of branch leaves not papillose.
6. Hyaline cells of branch leaves, especially on the outer surface, with pores numerous and crowded in commissural rows (generally resembling a string of beads). 8. *S. subsecundum* var. *rufescens*
6. Hyaline cells with pores fewer, not crowded in commissural rows.
7. Plants pale-green to yellowish or brownish; cortical cells of stems not porose; green cells of branch leaves in section triangular to ± trapezoidal, exposed exclusively or more broadly on the outer surface.
8. Young pendent branches appearing to be in pairs; branch leaves when dry with spreading tips and wavy margins. 7. *S. recurvum*
8. Young pendent branches not in pairs; branch leaves not particularly spreading or wavy when dry.
9. Retort cells of branch cortex with long-spreading necks. 6. *S. tenellum*
9. Retort cells less markedly differentiated. 9. *S. richardsianum*
7. Plants pinkish to reddish (or, when shaded, green but with some parts red-tinged); cells of stem cortex often uniporose; green cells of branch leaves in section triangular to trapezoidal with broader or exclusive exposure on the inner surface or narrowly lenticular with equal exposure on both surfaces.
10. Plants very soft, loosely tufted, and laxly foliate; branch leaves broadly concave, broadly oblong-ovate or elliptic, shortly involute-concave at the apex; hyaline cells of branch leaves on the outer surface normally with pores only near the leaf tips and very few, minute, and inconspicuous; green cells of branch leaves lenticular or truncately elliptic to narrowly rectangular in section, with equal exposure on both surfaces. 11. *S. meridense*
10. Plants less soft, compact, densely foliate; branch leaves oblong-lanceolate, slenderly involute-pointed; hyaline cells on the outer surface with pores throughout the leaf, numerous, small but conspicuous, at ends and corners, and often near the commissures as well; green cells in section triangular to trapezoidal and exposed exclusively or more broadly on the inner surface. 10. *S. sparsum*

Section Sphagnum

Cortical cells of stem nearly always reinforced on the inner surface with delicate spiral fibrils and generally porose at the outer surface. Stem leaves lingulate, fringed. Branch cortex usually spirally fibrillose, generally 1-porose. Branches stout and tumid; branch leaves broadly ovate to suborbicular, cucullate-concave, rough at back of the apex because of resorption of hyaline cells and narrowly denticulate-bordered because of

marginal resorption; pores on the outer surface of hyaline cells large, elliptic, at ends and corners, commonly in 2's or 3's at adjacent corners.

1. **Sphagnum magellanicum** Brid. – Plants stout, pink, red, or purplish (or, rarely, in shaded conditions, green), in compact cushions or hummocks. Wood cylinder of stem red; cortical cells in 3–4 layers, short-rectangular, thin-walled, delicately spirally fibrillose, with 1 or occasionally 2–4 large, rounded to elliptic pores. Stem leaves ± flat, oblong-lingulate, rounded at the apex, finely fringed at the margins; hyaline cells not divided, with fibrils none or only near the leaf apex, largely resorbed on the outer surface or sometimes on both surfaces. Branches relatively short, stout and tumid, in fascicles of 4–5 (2 spreading); cortical cells in 1 layer, short-rectangular, delicately fibrillose, the outer walls not porose or sometimes with 1 large, rounded pore at the upper end. Branch leaves imbricate or rarely somewhat spreading at the tip, ca. 2 mm long, broadly ovate, deeply cucullate-concave, denticulate and bordered by a single row of linear cells resorbed at their outer margins to form a furrow, rough at back of the apex because of resorption; hyaline cells plane or nearly so on both surfaces, fibrillose, on the outer surface with 2–5(10), large, elliptic pores (or occasionally pseudopores) at ends and corners and along the commissures, usually in groups of 3 at adjacent corners, fewer and passing into membrane gaps toward the leaf apex, on the inner surface with few (0–5) elliptic pores or pseudopores at corners and along the commissures in upper and lateral regions of the leaf, varying in size, often with 1 large, rounded to elliptic pore at the upper end; green cells in section small, elliptic, central, included. Dioicous. Spores 22–27 μm, obscurely roughened or nearly smooth. – Fig. A.

Not known to occur in Mexico but almost surely present on the highest peaks, as it occurs in Guatemala and rather commonly at higher elevations in other parts of Latin America, in compact cushions or hummocks in open, springy places. Common and widespread in Europe, northern Asia, and North America from Alaska to Greenland and south to California in the West and the Gulf of Mexico in the East; Bermuda; West Indies; Central America; northern South America to Tierra del Fuego; Falkland Islands; New Zealand.

The plants are stout and, at least when growing in the sun, reddish. The branch leaves are broad, cucullate-concave, rough at back of the apex, and narrowly denticulate-bordered owing to marginal resorption. The cortical cells of stems and branches are fibrillose. The branch leaves have hyaline cells nearly flat on both surfaces, and their green cells in section appear to be elliptic and entirely included.

In northern South America and few West Indian localities is another reddish member of the section *Sphagnum*, *S. alegrense* Warnst. It also has green cells of the branch leaves central and included, but the inner surfaces of hyaline cells, where they lie adjacent to green cells, are covered with very fine vermiform ridges which are demonstrable, with some difficulty, in longitudinal sections and in cross-sections appear as irregular, bumpy papillae. The cortical cells lack fibrils.

2. **Sphagnum palustre** L. – Plants robust, pale-green to yellowish or yellowish-brown, in cushions or carpets. Wood cylinder of stem brown; cortical cells in 3–4 layers, short-rectangular, thin-walled, delicately spiral-fibrillose, the outer cells with numerous, irregularly rounded pores, (1)2–7(11). Stem leaves ± flat, long-lingulate, rounded at the apex, finely fringed at the margins; hyaline cells not divided, frequently with membrane pleats and traces of fibrils, the outer surface largely resorbed or with fibrils and pores in addition to a large membrane gap, the inner surface fibrillose, non-porose. Branches stout and tumid, in fascicles of 4–5 (2 spreading); cortical cells in 1 layer, delicately fibrillose, frequently with a single, large pore. Branch leaves imbricate to spreading at the tips, broadly ovate, cucullate-concave, denticulate-bordered by 1 row of linear cells resorbed at their outer margins and forming a furrow, rough at back of the apex because of

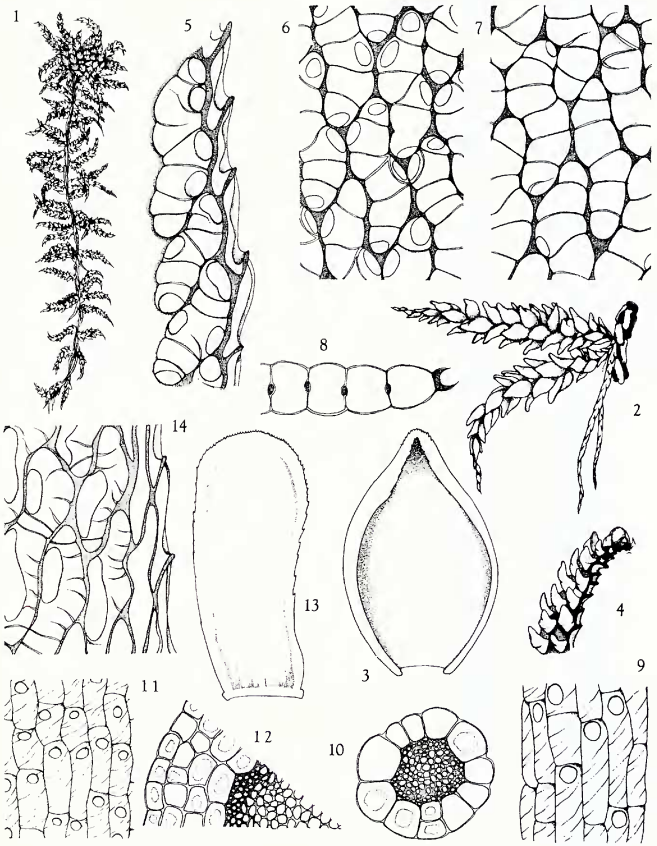

FIG. A. *Sphagnum magellanicum.* 1. Habit, X 1. 2. Fascicle of branches, X 3. 3. Branch leaf, X 27. 4. Resorption at back of the apex of a branch leaf, X 400. 5. Resorption at the margin of a branch leaf (as a resorption furrow), X 400. 6. Upper cells of branch leaf, outer surface, X 400. 7. Upper cells of branch leaf, inner surface, X 400. 8. Cross-section of branch leaf showing marginal resorption furrow, X 400. 9. Branch cortex, X 117. 10. Branch in cross-section, X 117. 11. Stem cortex, X 117. 12. Portion of stem in cross-section, X 117. 13. Stem leaf, X 27. 14. Upper cells of stem leaf, at margin, inner surface, X 400.

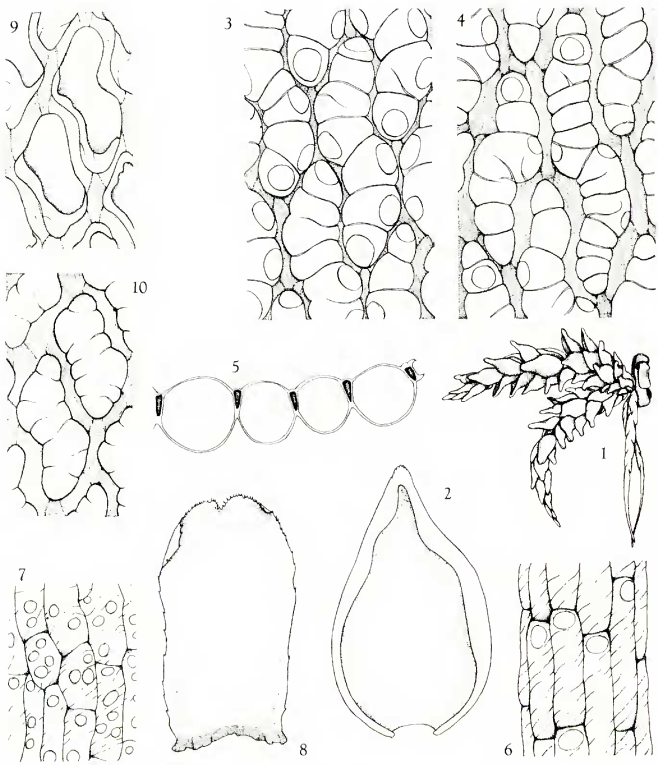

FIG. B. *Sphagnum palustre.* 1. Fascicle of branches, X 3. 2. Branch leaf, X 27. 3. Upper cells of branch leaf, outer surface, X 200. 4. Upper cells of branch leaf, inner surface, X 200. 5. Cross-section of branch leaf, X 200. 6. Branch cortex, X 117. 7. Stem cortex, X 117. 8. Stem leaf, X 27. 9. Upper cells of stem leaf, outer surface, X 400. 10. Upper cells of stem leaf, inner surface, X 400.

resorption; hyaline cells fibrillose, somewhat convex on the inner surface, more so on the outer surface which has large, rounded to elliptic end and corner pores, mostly in 2's and 3's at adjoining corners, and large, elliptic, ringed pores along the commissures, 3–7 above and sometimes as many as 10–13 below (sometimes especially numerous and ± rounded toward the basal margins), passing into single, large membrane gaps at the leaf apex, on the inner surface with pores none or few, elliptic to rounded in corners and often with a few large, rounded, unringed pores ± in the middle of cells, more numerous (2–8) near the leaf margins; green cells in section narrowly isosceles-triangular (or rarely ±

trapezoidal), exposed on the inner surface. Dioicous. Spores 24–29 μm, finely roughened or nearly smooth. – Fig. B.

In cushions or carpets in wet depressions or on seepage banks in shaded places at 6200 to 6800 ft. altitude. Eastern Mexico–Hidalgo (Apulco; Zacualtipán); Veracruz (Huayacocotla). Europe and Asia; Hawaii; British Columbia to California; Newfoundland to Wisconsin and south to the Gulf of Mexico; Jamaica. Records from South America, New Zealand, Australia, and Fiji need confirmation. Many of the South American records can be referred to a large, lax form of *S. perichaetiale.*

Sphagnum palustre tends to be yellowish or brownish. It has broad leaves hooded and roughened at the apex and denticulate along a marginal resorption furrow. The cortical cells of stems and branches are spirally fibrillose, and the cells of the stem cortex have numerous pores (sometimes as many as 11). The green cells of branch leaves, as seen in section, are narrowly triangular, with the base exposed on the inner surface.

Sphagnum imbricatum Hornsch. *ex* Russ. (Fig. C), similar in appearance to *S. palustre,* has been found in British Honduras. (A Guatemalan record, based on *Steyermark 49912,* can be referred to *S. subsecundum* var. *rufescens.*) The branch leaves in section

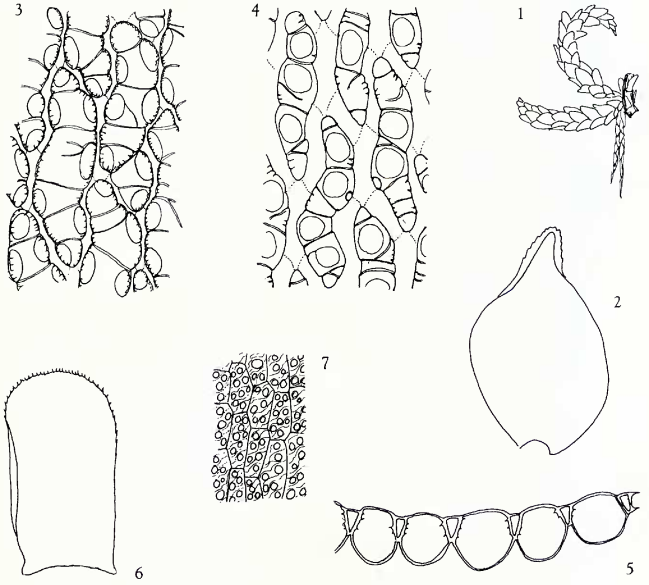

FIG. C. *Sphagnum imbricatum.* 1. Fascicle of branches, X 3. 2. Branch leaf, X 27. 3. Upper cells of branch leaf, outer surface, X 400. 4. Upper cells of branch leaf, inner surface, X 400. 5. Cross-section of branch leaf, X 400. 6. Stem leaf, X 27. 7. Stem cortex, X 117.

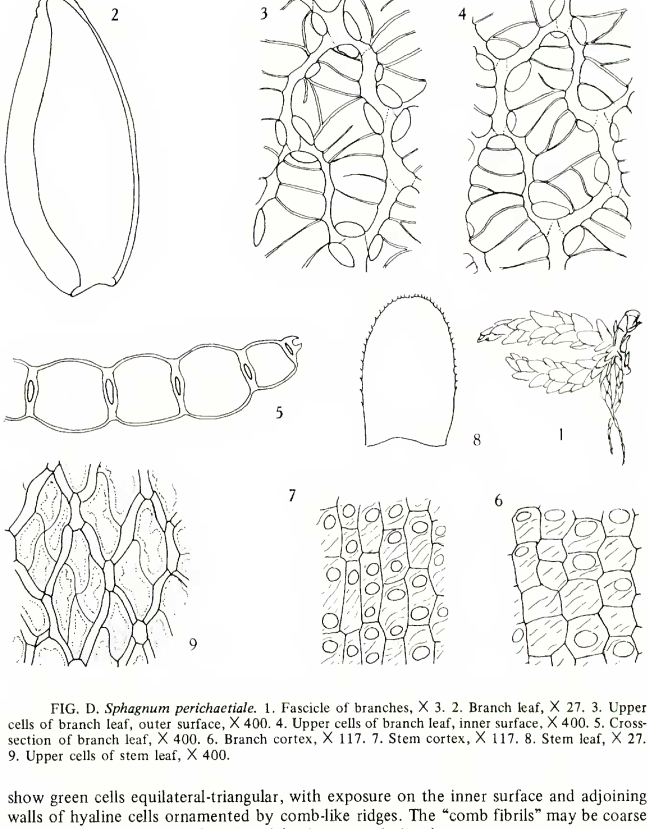

FIG. D. *Sphagnum perichaetiale.* 1. Fascicle of branches, X 3. 2. Branch leaf, X 27. 3. Upper cells of branch leaf, outer surface, X 400. 4. Upper cells of branch leaf, inner surface, X 400. 5. Cross-section of branch leaf, X 400. 6. Branch cortex, X 117. 7. Stem cortex, X 117. 8. Stem leaf, X 27. 9. Upper cells of stem leaf, X 400.

show green cells equilateral-triangular, with exposure on the inner surface and adjoining walls of hyaline cells ornamented by comb-like ridges. The "comb fibrils" may be coarse and conspicuous or variously reduced (perhaps even lacking).

Sphagnum perichaetiale Hampe (Fig. D), known from the Greater Antilles, northern South America, and British Honduras (as well as the Coastal Plain of the eastern United States), is likely to be found in Mexico. Usually the plants are small and compact, with stem and branch leaves much alike in size, shape, and structure, but larger plants of loose habit may have stem and branch leaves clearly differentiated. The branch leaves have on the outer surface of hyaline cells elliptic corner pores that are generally unperforated and easily overlooked. The green cells of the branch leaves are exceedingly variable in section; they are most often narrowly rectangular, but they can be especially narrow and even lenticular and exposed on both surfaces because of thickened end walls or narrowly

triangular and exposed on the inner surface. The plants are generally tinged with yellow, orange, pinkish-orange, or rarely red.

Eddy (Bull. Brit. Mus. Nat. Hist. 5: 357–445. 1977) showed that the name *S. erythrocalyx* Hampe *ex* C. M., which Andrews used in place of *S. perichaetiale,* belongs to a species with branch leaf sections similar to those of *S. magellanicum* (with green cells central and included), except for papillae on the inner walls of hyaline cells where they lie adjacent to green cells. *S. erythrocalyx* is a Brazilian species. *S. alegrense* Warnst., which was described on the basis of Brazilian material, is somewhat similar, but its hyaline cells have fine worm-like ridges along the commissures and therefore appear to be sparsely and irregularly papillose in section.

3. **Sphagnum portoricense** Hampe – Plants robust, dark, greasy-green above and brown below or yellow-brown throughout (generally yellow to brown throughout when dry), in extensive carpets. Wood cylinder of stem brown; cortical cells in 3–4 layers, irregularly quadrilateral, sometimes wider than long, thin-walled, delicately fibrillose, those at the surface with 1–6 irregularly rounded pores. Stem leaves lingulate, with a broad, finely meshed, hyaline fringe at the sides and around the broad apex; hyaline cells often 1–2-divided, about as wide as long near the leaf tip, narrower below, on the outer surface almost entirely resorbed, on the inner surface often showing small pores and traces of fibrils, especially near the leaf apex. Branches in fascicles of 4–5 (2 spreading), stout, tumid, club-shaped; cortical cells in 1 layer, increasing in size toward the branch tip, nested together by a funnel-shaped base ending in a pore, delicately fibrillose, the inner wall corrugated by dense cross-fibrils (the outer surface without pores). Branch leaves closely imbricate, dimorphous: leaves at the base of branches smaller than those toward the branch tips, cucullate-concave, broadly cordate-ovate, hyaline-fringed; hyaline cells nearly plane on the inner surface, strongly convex on the outer, on the outer surface almost entirely resorbed in the upper part of the leaf, in the lower part with 7–10 large, elliptic pores at corners and along commissures, on the inner surface with about 4 small, elliptic pores at the corners in the upper part of the leaf, those in the lateral regions more numerous, larger, and rounded; leaves of the upper part of branches much larger, denticulate along a resorption furrow, not hyaline-fringed, with hyaline cells resorbed on the outer surface only in a few apical cells; green cells in section equilateral-triangular, exposed on the inner surface (or rarely ± trapezoidal with narrow exposure on the outer surface), the inner walls of hyaline cells where they abut the green cells usually beset with fringe fibrils (sometimes evident only at leaf bases). Apparently dioicous. Spores 22–29 μm, finely roughened. – Fig. E.

On wet soil at 3800 ft. altitude; Mexico–Puebla (Villa Juárez). In tropical America on wet banks in mountains but in the Coastal Plain of eastern North America submerged in shallow water of pools and drainage ditches and extending upward above water level at the margins, sometimes also in swampy places submerged during part of the year. Along the coast from Maine and New York to Florida and Mississippi; Puerto Rico and Guadeloupe; Venezuela.

Sphagnum portoricense is recognized in the field by dark-green, wet-shiny, stout, club-shaped branches. The cortical cells of the branches are funnel-like and nested together; they lack pores at the surface; and their inner walls are densely corrugate-fibrillose. The leaves of the upper part of the branches are denticulate-bordered by a resorption furrow; those toward the branch bases are hyaline-fringed, as in the stem leaves. The green cells of branch leaves are broadly triangular in section, and the commissures of hyaline cells are normally covered by fringe fibrils.

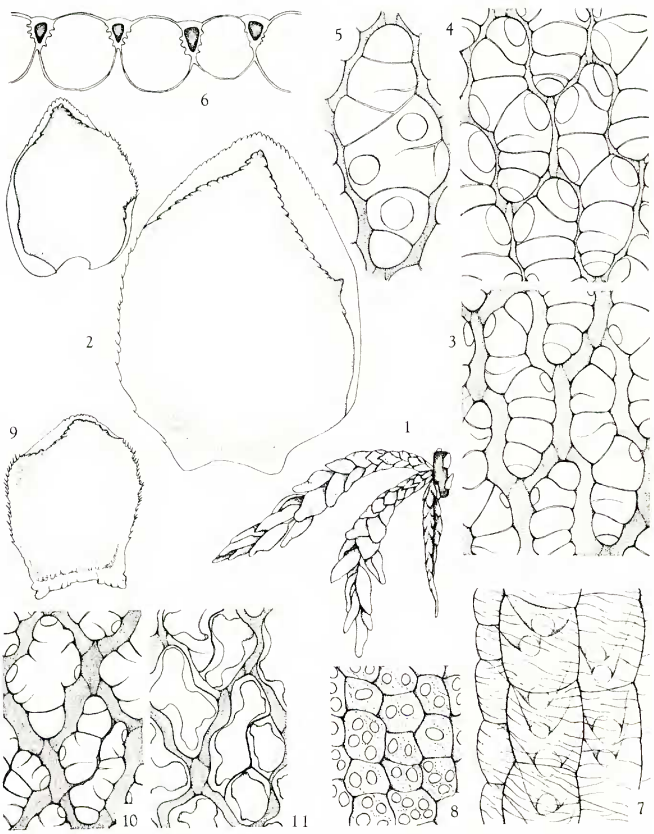

FIG. E. *Sphagnum portoricense*. 1. Fascicle of branches, X 3. 2. Branch leaves, X 27. 3. Upper cells of branch leaf, inner surface, X 400. 4. Upper cells of branch leaf, outer surface, X 400. 5. Upper cells of branch leaf, near margin, inner surface, X 400. 6. Cross-section of branch leaf, X 400. 7. Branch cortex, X 117. 8. Stem cortex, X 117. 9. Stem leaf, X 27. 10. Upper cells of stem leaf, inner surface, X 400. 11. Upper cells of stem leaf, outer surface, X 400.

Section Rigida

Cortical cells of stems and branches without fibrils, those of stems without pores, those of branches uniformly 1-porose at the upper ends. Stem leaves very small, lingulate to deltoid, scarcely bordered; hyaline cells not divided, without pores or fibrils. Branch leaves often squarrose-spreading, broadly ovate to elliptic, broadly truncate, concave because of inrolled margins, smooth at back of the apex, narrowly denticulate-bordered because of marginal resorption.

4. **Sphagnum strictum** Sull. (syn. *S. mexicanum* Mitt.). – Plants yellowish, generally in low, dense mats or small cushions. Wood cylinder of stem yellow-green; cortical cells in 1–3 layers, short-rectangular, thin-walled, without pores or fibrils. Stem leaves very small, bluntly deltoid, scarcely bordered; hyaline cells not divided, without fibrils or pores, sometimes with membrane pleats at the leaf apex, each cell on the inner surface with an irregular membrane gap which near the leaf apex occupies nearly the entire cell. Branches usually in fascicles of 5 (2 spreading); cortical cells in 1 layer, without fibrils, each ending in an apical pore. Branch leaves squarrose, ovate, involute-concave, and ending in a broadly truncate, toothed apex, ± denticulate along a marginal resorption furrow toward the leaf tip, smooth at back of the apex; hyaline cells distinctly convex on the inner surface, slightly so on the outer, fibrillose, on the outer surface toward the leaf apex with 2–6 large, rounded to rounded-elliptic, distinct but not ringed pores along the commissures, up to 12 or 16, more nearly elliptic, and more distinctly ringed below, on the inner surface with few (2–4), somewhat smaller, elliptic, strongly ringed pores in the corners and occasionally along the commissures, often in 2's and 3's at adjacent corners; green cells in section to narrowly triangular ± trapezoidal, exposed on both surfaces or only on the outer, the inner walls of hyaline cells where they abut the green cells usually faintly papillose. Dioicous. Spores 31–39 μm, finely roughened or nearly smooth. – Fig. F.

In seepage on roadbanks at about 3000 to 4000 ft. altitude (but in the Coastal Plain of southeastern United States on sandy soil in open, grassy places). Mexico–Hidalgo (Tenango de Doria); Oaxaca (*sine loco*, type of *S. mexicanum*). Andrews (Bryol. 16: 23. 1913) reported that a specimen at the Copenhagen Botanical Garden, designated as "Mexico, *Liebmann*, Musci 10," was wrongly named by Schimper as *S. squarrosum*. Northwestern and central Europe; Newfoundland to Florida and Louisiana, primarily in the Coastal Plain; Santo Domingo and Guadeloupe; Venezuela and Ecuador. The type of *S. mexicanum* and material from Guadeloupe and Santo Domingo were referred by Eddy to the ssp. *pappeanum* (C. M.) Eddy, otherwise known from Africa and Malaysia. The subspecies is said to differ slightly in anatomical detail and somewhat more robust stature (which in Africa grades into the ssp. *strictum*).

The plants form low and usually compact cushions or small mats. The stem leaves are much smaller than the branch leaves. The cells of the branch cortex are uniformly porose at slightly protruding upper ends. The spreading to squarrose branch leaves are broadly truncate, with margins denticulate-bordered above because of resorption. Very fine papillae are usually present on the inner walls of hyaline cells where they adjoin the green cells.

Sphagnum strictum differs from the widespread *S. compactum* Lam. & DC most notably in the absence of pseudopores in the hyaline cells of branch leaves and in the exposure of green cells on the outer surface. *S. compactum* has green cells central and included. It has been found in Guatemala in an alpine meadow at 3100–3150 m altitude; the specimen, *Steyermark 49918*, was referred by Bartram to *S. magellanicum*. Widespread in the Northern Hemisphere, it has also been found in northern South America.

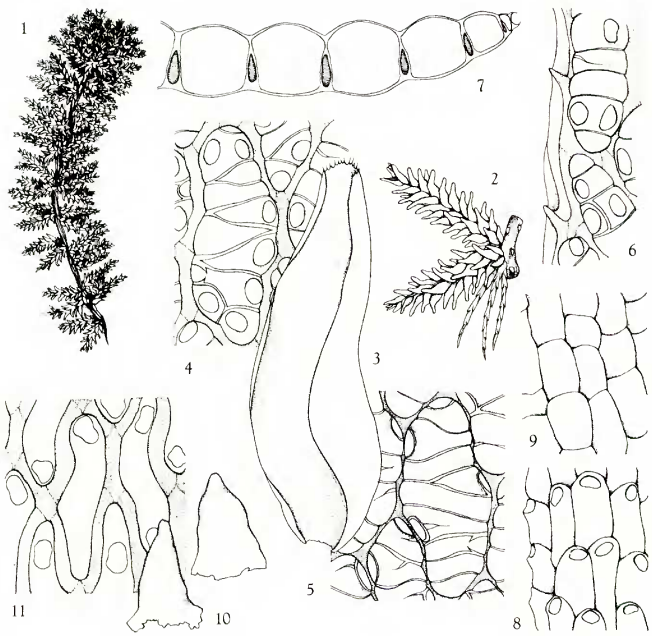

FIG. F. *Sphagnum strictum.* 1. Habit, X 1. 2. Fascicle of branches, X 3. 3. Branch leaf, X 27. 4. Upper cells of branch leaf, outer surface, X 400. 5. Upper cells of branch leaf, inner surface, X 400. 6. Upper cells of branch leaf and marginal resorption furrow, X 400. 7. Cross-section of branch leaf, X 300. 8. Branch cortex, X 117. 9. Stem cortex, X 117. 10. Stem leaves, X 27. 11. Upper cells of stem leaf, inner surface, X 400.

Section Squarrosa

Terminal bud large. Cortical cells of stem without fibrils, sometimes with a single pore or pore-like thin spot at the upper end. Stem leaves elliptic, perforate to slightly fringed at the broad apex; hyaline cells undivided, without fibrils, on the outer surface mostly resorbed, on the inner surface resorbed only in the apical portion of the leaf. Cortical cells of branches without fibrils, some enlarged with a single pore terminating an apical projection. Branch leaves generally spreading- to squarrose-tipped at least when dry, ovate-hastate to ovate-lanceolate, narrowly truncate, involute-concave, entire at the margins and narrowly bordered by several rows of linear cells; hyaline cells on the outer surface with large, rounded to rounded-elliptic pores, on the inner surface with large, elliptic pores with distinct or ringed margins; green cells exposed exclusively or more broadly on the outer surface, with the adjacent walls of hyaline cells faintly papillose.

5. **Sphagnum squarrosum** Crome – Relatively robust plants in loose, pale-green to yellowish carpets. Terminal bud large. Wood cylinder green to red-brown; cortical cells of stem in 2–3 layers, short-rectangular, without fibrils or pores. Stem leaves only slightly concave, relatively large, oblong-lingulate, perforate or slightly fringed at a rounded apex, not or indistinctly bordered; hyaline cells mostly undivided and without fibrils, on the outer surface almost entirely resorbed, on the inner surface with membrane pleats, only at the leaf apex with membrane gaps. Branches in fascicles of 5 (2 spreading); cortical cells in 1–2 layers, without fibrils, the retort cells with inconspicuous necks. Branch leaves squarrose from an erect base, ca. 2–2.5 mm long, broadened from the base upward and abruptly narrowed at the middle to an involute-concave acumen, toothed across a narrowly truncate apex, bordered by 2–3 rows of linear cells; hyaline cells somewhat convex on both surfaces (somewhat more so on the inner), often faintly papillose on the inside where they adjoin green cells, fibrillose, on the outer surface in the upper portion of the leaf with 1–3 rounded to rounded-elliptic, non-ringed pores at ends and corners, in the lower median region with 10 or more large pores in 1–2 rows, on the inner surface with 4–7 large, rounded-elliptic, ringed pores at ends and along commissures; green cells in section triangular or trapezoidal, exposed exclusively or more broadly on the outer surface. Monoicous. Spores 17–27 μm, smooth or nearly so to finely papillose. – Fig. G.

The Mexican habitat is unknown. In temperate regions, the plants characteristically grow in base-rich woodland habitats, in wet depressions in *Thuja* swamps, for example. In boreal and arctic latitudes, the species grows in willow thickets or in open, calcareous fens. In montane situations, it occurs on wet rock ledges. The sole collection from Mexico, in the herbarium of the Field Museum of Natural History, was made by Harde Le Sueur in Chihuahua, in the Chupic Lake area (near Chuhuichupa, municipio de Madera, at 7500 ft. altitude, on August 25, 1937. – Norton Miller provided me with information on the locality of Chupie Lake. His information came from data on Le Sueur's collections assembled by I. M. Johnston and preserved at the Arnold Arboretum). Widespread in Europe, south at least to Romania and the Armenian SSR; China and Japan; Greenland to Alaska and southward to Arizona, Colorado, Iowa, and the Great Lakes region and in the mountains to North Carolina and Tennessee. Reported from India, Korea, eastern Siberia, and New Zealand.

Sphagnum squarrosum, when well developed, can be recognized at a glance by its large size and conspicuously squarrose branch leaves. Other features of note include a large terminal bud, extensive resorption on both surfaces at the broad apex of stem leaves, and abruptly acuminate branch leaves with hyaline cells having ringed pores on the inner surface.

Section Cuspidata

Plants mainly in depressions, sometimes submerged, often yellowish to brownish. Cortical cells of stems often poorly differentiated, without pores or fibrils. Stem leaves extensively resorbed on the inner surface (and in some species on both surfaces across the apex or down the middle of the leaf resulting in laceration). Cortical cells of branches not fibrillose, some of them enlarged, apically porose, and retort-shaped. Branch leaves involute-concave, especially when moist, ± flattened out and often wavy at the margins when dry, ovate to lanceolate, narrowly truncate, entire-margined and narrowly bordered by linear cells; hyaline cells convex on the inner surface, variously porose on 1 or both surfaces; green cells with exclusive or broader exposure on the outer surfaces.

6. **Sphagnum tenellum** Ehrh. *ex* Hoffm. – Plants small, soft, delicate, in loose, pale, green, yellowish-green, or brownish carpets. Branches of the capitulum somewhat curved. Stems brown; wood cylinder yellow-green; cortical cells moderately enlarged and thin-walled in 2–3 layers, short-rectangular, without fibrils or pores. Stem leaves much like branch leaves, 1.3–1.4 mm long, oblong-elliptic, concave and seemingly broadly acute because of incurved upper margins, with a narrow border which is not or only slightly

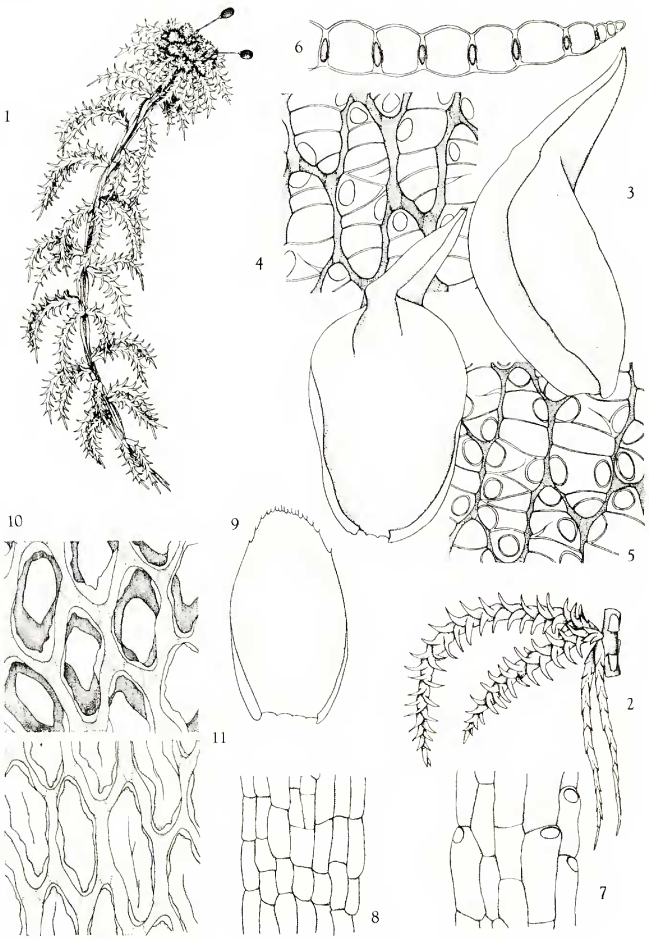

FIG. G. *Sphagnum squarrosum.* 1. Habit, X 1. 2. Fascicle of branches, X 3. 3. Branch leaves, X 27. 4. Upper cells of branch leaf, outer surface, X 400. 5. Upper cells of branch leaf, inner surface, X 400. 6. Cross-section of branch leaf, X 400. 7. Branch cortex, X 117. 8. Stem cortex, X 117. 9. Stem leaf, X 27. 10. Upper cells of stem leaf, near apex, showing resorption on both surfaces, X 400. 11. Upper median cells of stem leaf, inner surface, X 400.

broadened at base; hyaline cells narrow below, broader toward the leaf apex, not divided (or occasional cells 1-divided), fibrillose in the upper 1/2 or nearly to the base, on the outer surface with 1–4 small, ringed pores at ends and corners, on the inner surface with 1–2 large, non-ringed pores at ends or corners or ± large membrane gaps, especially toward the sides of the leaf apex. Branches in fascicles of 3–5 (1–3 spreading); cortical cells in 1 layer, without fibrils, the retort cells with very conspicuous necks. Branch

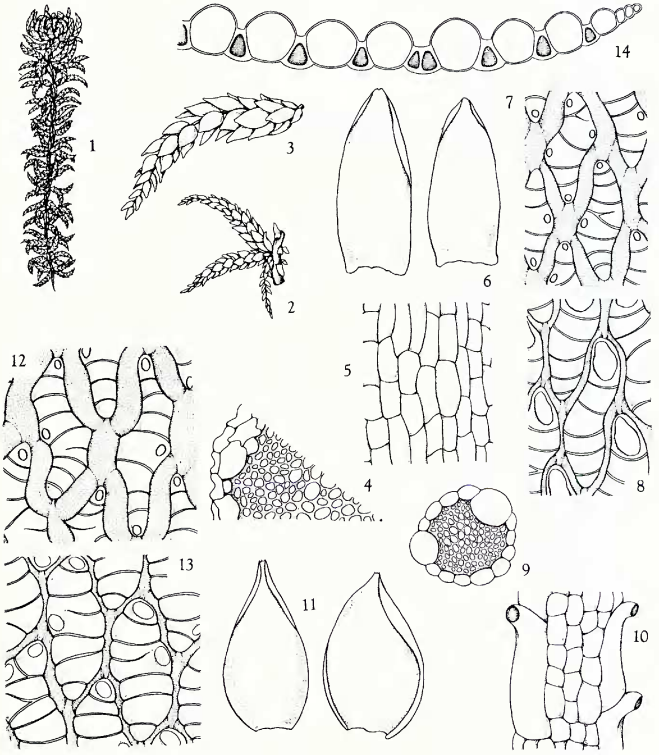

FIG. H. *Sphagnum tenellum.* 1. Habit, X 1. 2. Fascicle of branches, X 3. 3. Spreading branch, X 7. 4. Portion of stem in cross-section, X 117. 5. Stem cortex, X 117. 6. Stem leaves, X 27. 7. Upper cells of stem leaf, outer surface, X 400. 8. Upper cells of stem leaf, inner surface, X 400. 9. Branch in cross-section, X 117. 10. Retort cells of branch cortex, X 117. 11. Branch leaves, X 27. 12. Upper cells of branch leaf outer surface, X 400. 13. Upper cells of branch leaf, inner surface, X 400.

leaves not crowded, loosely spreading or somewhat incurved to subsecund, concave, ca. 1.3 mm long, oblong-ovate to elliptic, appearing broadly acute when dry but shortly involute-pointed when moist, toothed at the apex, bordered by 2–3 rows of narrow cells; hyaline cells very convex on the inner surface but only slightly so on the outer, fibrillose, on the outer surface with 2–4 small, round, ringed pores at ends and corners, on the inner surface with 2–3 large, round, non-ringed pores; green cells in section broadly triangular or sometimes trapezoidal with a broader exposure on the outer surface. Dioicous. Spores 27–31 μm, very finely roughened or nearly smooth. – Fig. H.

In seepage from springs or on wet banks of streams at 6200 to 9800 ft. altitude (sometimes growing with *Breutelia* and *Rhacocarpus*). Eastern Mexico–Oaxaca (Sierra Juárez; Llano de las Flores). Northern and Central Europe; Japan; southeastern Alaska and British Columbia; Greenland; Newfoundland to northern Ontario and south to New York, New Jersey, and the mountains of North Carolina; Brazil and Ecuador.

The small, delicate plants grow in loose, pale carpets. The well-spaced, broad leaves are rather flat when dry, but not wavy-margined. The stem and branch leaves are similar in shape and structure, and the retort cells of the branch cortex are remarkably long-necked.

7. **Sphagnum recurvum** P.-Beauv. (syn. *S. pulchricoma* C. M.) – Plants usually moderately robust, in bright-green to yellow-brown carpets. Capitulum often conspicuously 5-radiate; young pendent branches as seen between the arms of the capitulum appearing to be paired; leaves of young spreading branches noticeably spiral-ranked when moist; tip of stem and base of spreading branches sometimes flushed with red; apical bud not noticeable. Wood cylinder of stem yellow-green; cortical cells poorly differentiated in 1 layer, long-rectangular, without fibrils or pores. Stem leaves flat, 0.7–1.3 mm long, usually somewhat longer than broad, ± lingulate or less commonly broadly triangular, moderately erose across a broadly rounded or truncate, flat apex, the border of linear cells broader at base but not abruptly widened or sharply differentiated; hyaline cells not divided, without pores or fibrils (or rarely ± fibrillose above), mostly resorbed on the inner surface toward the apex. Branches in fascicles of 5 (with 2–3 spreading); cortical cells in 1 layer, without fibrils, the retort cells with inconspicuous necks. Branch leaves ± flattened out, recurved at the tips, and wavy at the margins when dry, lanceolate, involute-concave, and erect, with incurved margins when moist, 1.3–1.4 mm long, bordered by 2–4 rows of linear cells, entire except across the narrow, truncate apex; hyaline cells nearly plane on the outer surface, slightly convex on the inner, fibrillose, on the outer surface with a moderately large and rather conspicuous round pore at the upper end and near the apex of the leaf with a few small, ringed pores in corners and along commissures, on the inner surface with 3–7 rather large, round, unringed pores at corners and near the commissures (usually evident only on strong staining); green cells in section isosceles-triangular, with the base exposed on the outer surface, the apex of the triangle usually reaching the inner surface. Dioicous. Spores 24–27 μm, finely roughened to nearly smooth. – Fig. I.

In relatively base-rich depressions in open or shaded peatlands. Eastern Mexico–Veracruz (Huayacocotla). Widely distributed in boreal and temperate latitudes in Europe and North America (and probably across northern Asia as well); across Canada to Alaska and south to California in the West; throughout eastern United States, though more common northward; Cuba; northern South America.

Sphagnum recurvum tends to develop yellow to yellow-brown tinges, although shade forms can be a bright-green. The capitulum can be conspicuously 5-radiate. Between the rays the young pendent branches appear to be paired. A pink flush is common at the base of spreading branches and near the tip of the stem. The branch leaves, at

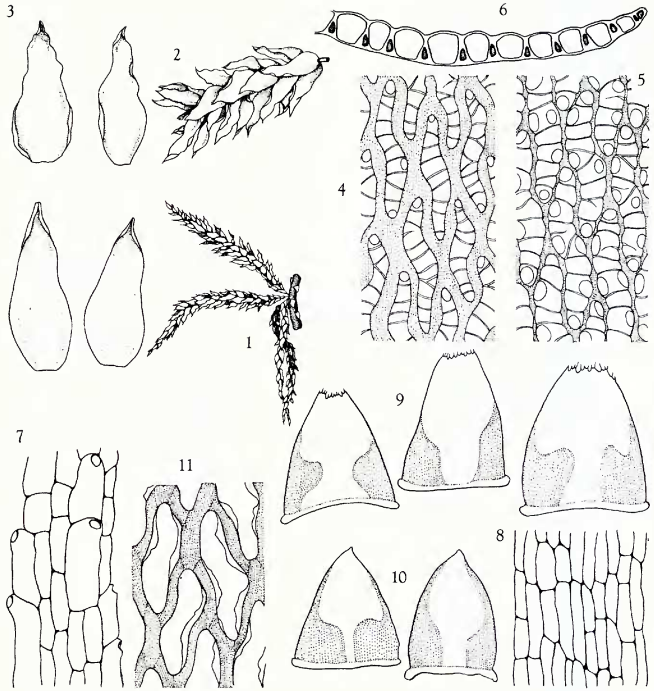

FIG. I. *Sphagnum recurvum.* 1. Fascicle of branches, dry, X 3. 2. Spreading branch, dry, X 10. 3. Branch leaves, dry (above), moist (below), X 27. 4. Upper cells of branch leaf, outer surface, X 400. 5. Upper cells of branch leaf, inner surface, X 400. 6. Cross-section of branch leaf, X 400. 7. Branch cortex, X 117. 8. Stem cortex, X 117. 9. Stem leaves (var. *recurvum*), X 27. 10. Stem leaves (var. *brevifolium*), X 27. 11. Upper cells of stem leaf, inner surface, X 400.

least on young spreading branches of the capitulum, are noticeably spiral-seriate when moist. On drying the branch leaves are relatively flat, with spreading or recurved tips and wavy margins. The hyaline cells of branch leaves have few pores on the outer surface, but a rather small, rounded pore at the upper ends of cells is rather conspicuously window-like; on the inner surface are numerous rounded pores with thin margins, noticeable on strong staining. The stem leaves are broadly lingulate and somewhat erose at a broad, truncate or more or less rounded apex.

The var. *recurvum* (Fig. I 1–9) includes *S. pulchricoma* in synonymy. Other names for the same form include *S. flexuosum* Dozy & Molk. and *S. amblyphyllum* (Russ.) Zick.

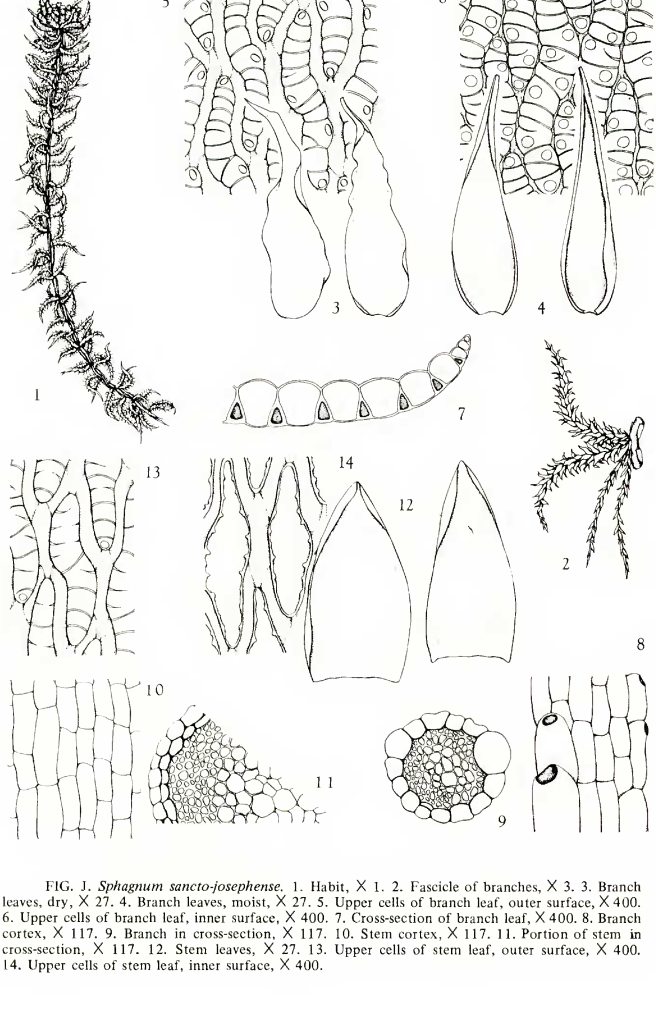

FIG. 1. *Sphagnum sancto-josephense.* 1. Habit, X 1. 2. Fascicle of branches, X 3. 3. Branch leaves, dry, X 27. 4. Branch leaves, moist, X 27. 5. Upper cells of branch leaf, outer surface, X 400. 6. Upper cells of branch leaf, inner surface, X 400. 7. Cross-section of branch leaf, X 400. 8. Branch cortex, X 117. 9. Branch in cross-section, X 117. 10. Stem cortex, X 117. 11. Portion of stem in cross-section, X 117. 12. Stem leaves, X 27. 13. Upper cells of stem leaf, outer surface, X 400. 14. Upper cells of stem leaf, inner surface, X 400.

What American authors have generally considered the typical expression of *S. recurvum* has stem leaves acute to concave-apiculate and entire at the apex (Fig. I 10). It can be called the var. *brevifolium* (Lindb. *ex* Braithw.) Warnst. It has been called *S. fallax* (Klinggr.) Klinggr., *S. mucronatum* (Russ.) Zick., and *S. apiculatum* H. Lindb. *in* Bauer.

Sphagnum sancto-josephense Crum & Crosby (Fig. J), described from Costa Rica and widespread, perhaps common, in northern South America, much resembles *S. recurvum*. It has oblong, concave-acute stem leaves with hyaline cells fibrillose on the outer surface toward the apex; the inner surface is largely resorbed, but stumps of fibrils may be seen at the margins of the uppermost cells.

Sphagnum cuspidatum var. *serrulatum* (Schlieph.) Schlieph. (syn. *S. trinitense* C. M.), widely distributed in coastal regions of eastern North America, the West Indies, and northern South America, has been found in Honduras. An aquatic, it has leaves somewhat flattened out and wavy when dry. The branch leaves are long and narrow, and at the branch tips especially long-subulate and, when dry, loosely flexuose; the margins (especially in elongate leaves at branch tips) are serrulate toward the apex and sometimes well below it. The variety (Fig. K 7–8) is, in most of its structural features, much like the var. *cuspidatum* (Fig. K 1–6), but it is rather more robust and tends to have hyaline cells of stem leaves once-divided, whereas those of the var. *cuspidatum* are undivided.

Section Subsecunda

Plants in small tufts or cushions, in wet depressions, often tinged with orange. Cortical cells of stems not fibrillose, sometimes 1-porose at the upper end. Stem leaves rather small but sometimes larger than branch leaves and sometimes similar to them in shape and structure, narrowly bordered by linear cells, the border not conspicuously widened at base; hyaline cells sometimes divided, usually fibrillose and porose at least near the apex, sometimes nearly throughout, with numerous commissural pores on 1 or both surfaces. Cortical cells of branches not fibrillose, some of them large, apically porose, and retort-shaped. Branches often curved (especially in the capitulum). Branch leaves often ± secund, ovate-lanceolate to ovate or elliptic, narrowly truncate, involute-concave, entire-margined and narrowly bordered by linear cells; hyaline cells on the outer surface usually with many ringed, elliptic pores crowded along the commissures, on the inner surface with pores none to numerous; green cells with exposure ± equal, greater on the outer surface, or (rarely) greater on the inner surface.

8. **Sphagnum subsecundum** Nees *ex* Sturm, *sensu lato* – Plants rather small to fairly robust, green or more often yellow-brown to orange. Branches of capitula often curved. Stems usually brown; wood cylinder yellow-green to brown; cortical cells in 1–4 layers, subquadrate to short-rectangular, thin-walled, without fibrils or pores, or sometimes with cracks, rounded membrane thinnings, or actual pores at upper ends. Stem leaves much shorter than branch leaves or to varying degrees larger and resembling branch leaves in size, shape, and structure, concave, deltoid to oblong-lingulate or elliptic, rounded at the apex, with a narrow border which is not much broadened at base; hyaline cells not at all or commonly divided, in more isophyllous forms with pores and fibrils on both surfaces, sometimes nearly throughout, the pores often crowded in rows along the commissures, in other forms with fibrils and pores only at the extreme apex, sometimes without fibrils but with membrane pleats, on the inner surface with irregular gaps in cells of the immediate apex, with membrane pleats below, sometimes porose. Branches in fascicles of 2–6 (2–3 spreading); cortical cells in 1 layer, without fibrils, the retort cells with inconspicuous necks. Branch leaves often subsecund, oblong-ovate to suborbicular, involute-tapered, toothed at the narrow apex, bordered by 2–3 rows of narrow cells; hyaline cells slightly convex on both surfaces, sometimes slightly more so on the inner, fibrillose, on the outer surface with pores usually 10–20 or more, small, elliptic, ringed,

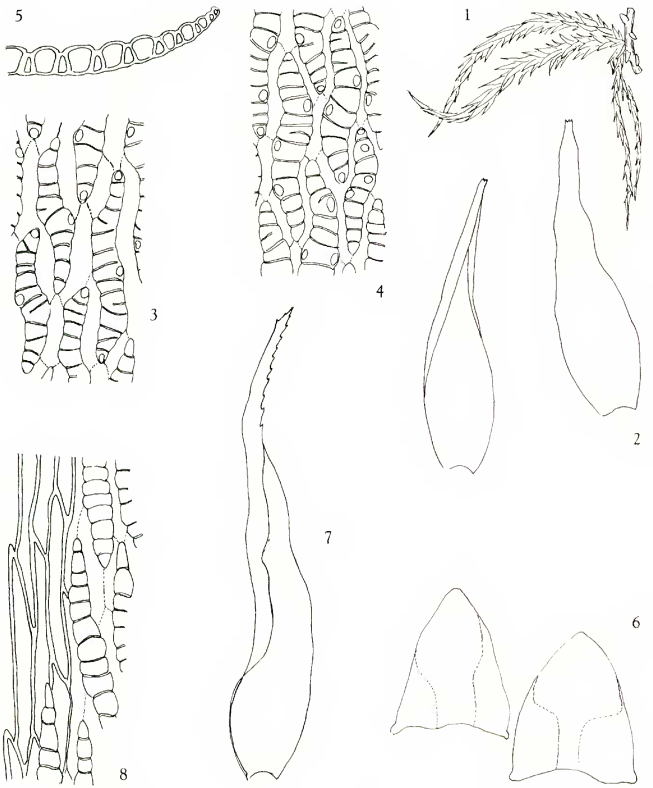

FIG. K. *Sphagnum cuspidatum* var. *cuspidatum*. 1. Fascicle of branches, X 3. 2. Branch leaves, X 27. 3. Upper cells of branch leaf, outer surface, X 400. 4. Upper cells of branch leaf, inner surface, X 400. 5. Cross-section of branch leaf, X 400. 6. Stem leaves, X 27. Var. *serrulatum*. 7. Branch leaf, X 27. 8. Margin of upper part of branch leaf, X 400.

often arranged along the commissures like a string of beads, sometimes with pseudopores and occasional compound pores (2–3 minute pores enclosed in a ring), on the inner surface with pores none or few, small, and rounded, in the angles or quite numerous along the commissures; green cells in section truncately elliptic and equally exposed on both surfaces or variously trapezoidal with broader exposure on the outer surface. Dioicous. Spores 22–24 μm, smooth.

Var. *rufescens* (Nees, Hörnsch. & Sturm) Hub. (syn. *S. flavicans* Warnst.) – Stem cortex in 1 layer (sometimes rather irregularly so). Stem leaves oblong-ovate to lingulate, 1.3–2.5 mm long; hyaline cells often divided, fibrillose and porose in the upper 1/3–1/2 or nearly throughout, with many pores along the commissures on both surfaces, or occasionally few or none on the inner surface. Branch leaves 1.5–2.2 mm long; hyaline cells on the outer surface with many pores crowded along the commissures, on the inner surface with pores and pseudopores in continuous or interrupted rows along the commissures, occasionally few or none. – Fig. M 3–4.

In small cushions on wet banks at 8000 to 9000 ft. altitude. Eastern Mexico–Chiapas (between San Cristobal de las Casas and Tenejapa); Oaxaca (W of Oaxaca, type of *S. flavicans*); Veracruz (Huayacocotla). Widespread in Europe; California; Newfoundland to Wisconsin, south to Florida and Texas; Guatemala (reported by Bartram as *S. subsecundum, Sharp 4968,* and *S. imbricatum, Steyermark 49912*); British Honduras.

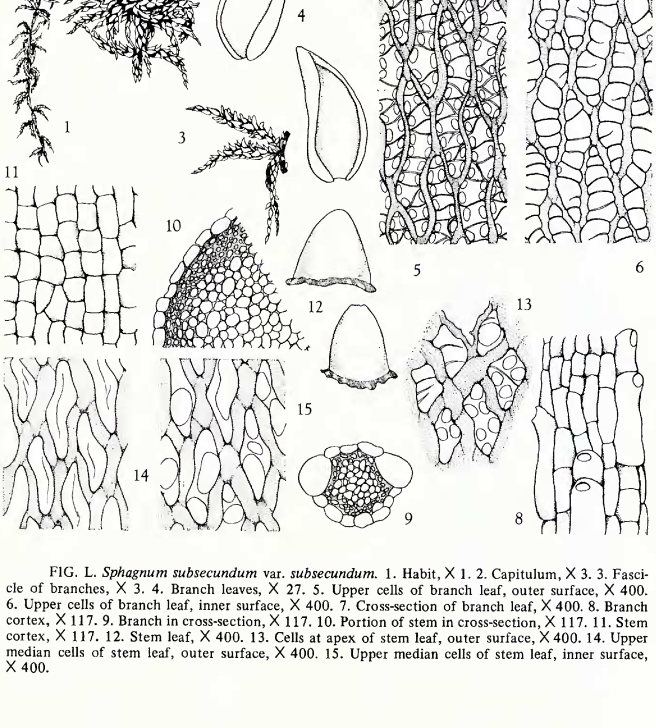

FIG. L. *Sphagnum subsecundum* var. *subsecundum.* 1. Habit, X 1. 2. Capitulum, X 3. 3. Fascicle of branches, X 3. 4. Branch leaves, X 27. 5. Upper cells of branch leaf, outer surface, X 400. 6. Upper cells of branch leaf, inner surface, X 400. 7. Cross-section of branch leaf, X 400. 8. Branch cortex, X 117. 9. Branch in cross-section, X 117. 10. Portion of stem in cross-section, X 117. 11. Stem cortex, X 117. 12. Stem leaf, X 400. 13. Cells at apex of stem leaf, outer surface, X 400. 14. Upper median cells of stem leaf, outer surface, X 400. 15. Upper median cells of stem leaf, inner surface, X 400.

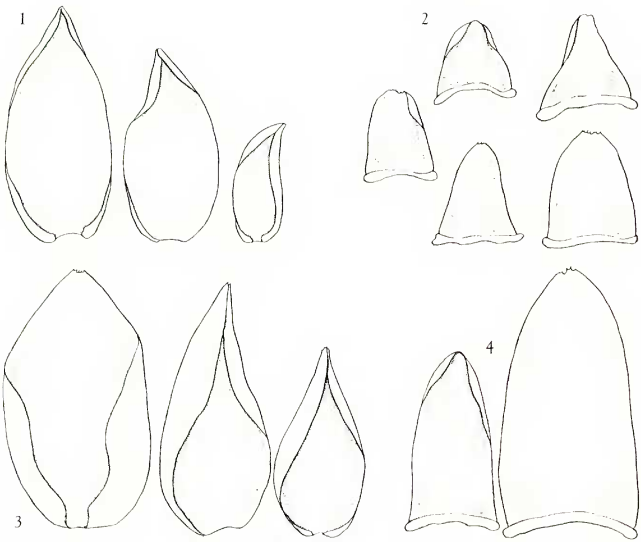

FIG. M. *Sphagnum subsecundum* varieties. 1. Branch and 2. stem leaves of var. *subsecundum*, X 27. 3. Branch and 4. stem leaves of var. *rufescens*, X 27.

Sphagnum subsecundum is a complex of intergrading forms that must be viewed with suspicious conservatism, although some of the many names that have fallen into its synonymy need recognition at some taxonomic level, not necessarily specific. The var. *subsecundum* (Fig. L, M 1–2) causes little trouble: The stem cortex consists of one layer of cells; the stem leaves are smaller than the branch leaves, deltoid to oblong, and more or less fibrillose and/or porose at the extreme tip. The wide-ranging and exceedingly variable var. *rufescens* (Fig. M 3–4) has cells of the stem cortex essentially one-layered (but sometimes, most irregularly and indistinctly, more or less two-layered); the stem leaves are half as long as the branch leaves or even longer, oblong-lingulate, and porose and fibrillose in the upper third to half or more; the pores are especially numerous on the outer surface of stem leaves, where they occur in commissural rows, but they are usually few or lacking on the inner surface.

9. **Sphagnum richardsianum** Crum – Plants small, soft, pale-green or yellowish, sometimes orange-brown above. Cortical cells of stems moderately differentiated in 2 layers, short-rectangular, without pores or fibrils. Stem and branch leaves similar: Stem leaves somewhat concave, 1.6–2.2 mm long, ovate-elliptic, broadly rounded to truncate at the apex, bordered by 2–3 rows of linear cells, entire except for coarse dentations across the apex; hyaline cells fibrillose throughout, not or rarely 1-divided, on the outer surface near the leaf apex with 3–6 very small, rounded, unringed pores, mostly at

corners, and often few to numerous, sometimes crowded pseudopores at the commissures, in the lower part of the leaf with 1–4 small, rounded pores at or near the corners and no pseudopores, on the inner surface near the apex with a few small, rounded, unringed pores or pseudopores at the corners and elsewhere along the commissures, in the lower portions with 1–5 small, rounded-elliptic pores mainly at the corners, very numerous along the commissures at the basal margins of the leaf. Branches in fascicles of 3 (2 ± spreading); cortical cells in 1 layer, without fibrils, the retort cells with inconspicuous necks. Branch leaves deeply concave when moist, less so when dry, erect or erect-spreading, not at all secund, 1.5–2 mm long, ovate, bordered by 2–3 rows of linear cells, dentate across the broad though concave apex; hyaline cells bulging on both surfaces,

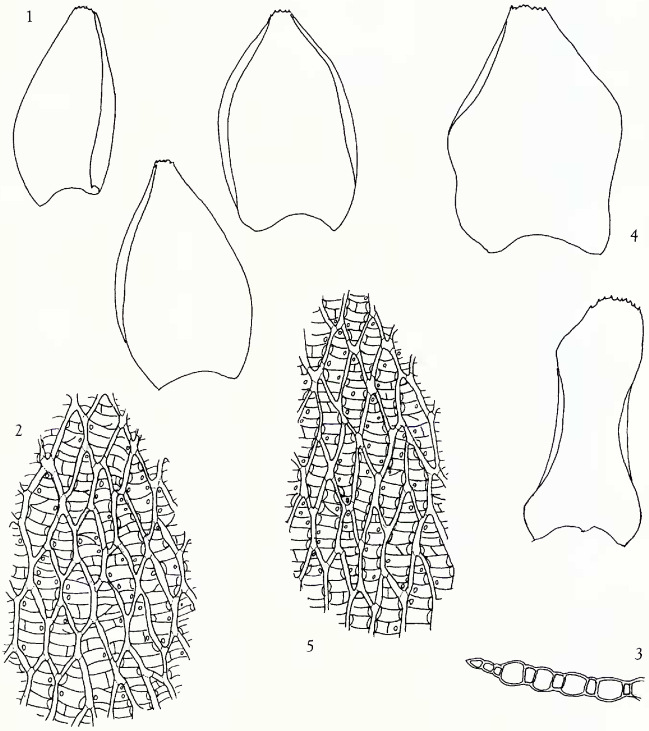

FIG. N. *Sphagnum richardsianum.* 1. Branch leaves, X 22. 2. Upper cells of branch leaf, outer surface, X 260. 3. Cross-section of branch leaf, X 260. 4. Stem leaves, X 22. 5. Upper cells of stem leaf, outer surface, X 260.

fibrillose throughout, undivided or in some leaves occasional cells repeatedly divided lengthwise, on the outer surface near the apex with 1–7 small, rounded-elliptic, ± ringed pores at the corners or scattered along the commissures, also with numerous pseudopores, on the inner surface with pores very few, small, and rounded, or more often none, with some pseudopores; in section green cells truncately elliptic or rectangular, broadly and equally exposed on both surfaces or with a slightly broader exposure on the outer surface. – Fig. N.

Oaxaca, in a cloud forest on Highway 175 on the east side of Sierra Juárez between Oaxaca and Tuxtepec; Guatemala (Baja Verapaz, *Sharp 5143*, CU, as *S. subsecundum*).

The stem and branch leaves are essentially isomorphous. The stem leaves are broadly ovate-elliptic, somewhat concave, and broadly truncate or more or less rounded at a dentate apex; the margins are bordered by linear cells; the hyaline cells are fibrillose throughout; the pores are few and very small, but in the upper part of the leaf, on the outer surface, pseudopores may be quite numerous and sometimes crowded in commissural rows. The branch leaves are somewhat smaller, ovate, and deeply concave; concavity obscures the fact that the apex is broad; the hyaline cells generally have rather few pseudopores even near the apex (although they are sometimes rather numerous).

An orange-brown pigmentation, more or less equal exposure of green cells of branch leaves, and the occurrence of pseudopores in something of a beaded arrangement make placement in the Subsecunda reasonable, although resemblances to *S. fitzgeraldii* Ren. *ex* Lesq. & James, in the Cuspidata, are rather disturbing.

Section Acutifolia

Plants often reddish, generally compactly tufted in cushions or hummocks. Cortical cells of stem without fibrils, sometimes 1-porose. Stem leaves about as long as branch leaves, nearly flat to ± concave, oblong-lingulate to ovate, rounded-obtuse to involute-pointed, bordered by linear cells, the border sometimes abruptly broadened at the base; hyaline cells often divided once to several times, without fibrils and pores and with membrane pleats on the outer surface or fibrillose with pores or gaps on the outer surface, in either case generally largely resorbed on the inner surface. Cortical cells of branches without fibrils, some of them large, apically porose, and retort-shaped. Branch leaves involute-concave, ovate-lanceolate, narrowly truncate, entire-margined and narrowly bordered by linear cells (very rarely with marginal resorption); hyaline cells strongly convex on the outer surface, fibrillose, on the outer surface with ringed and elliptic (or rarely rounded) pores at corners and along the commissures, usually rather numerous, on the inner surface with pores more rounded and thin-margined; green cells with exclusive or broader exposure on the inner surface.

10. **Sphagnum sparsum** Hampe – Plants rather slender, in low, compact mats, pinkish or yellowish-green. Capitula dense, rounded. Wood cylinder of stem yellowish-pink; cortical cells in 4 layers, short-rectangular, thin-walled, without fibrils, the outer cells generally porose at the upper ends. Stem leaves oblong or oblong-ovate, somewhat concave at the broadly acute and slightly erose apex, the border narrow above, slightly broadened at the base, the median basal cells somewhat enlarged in a triangular area; hyaline cells commonly 1(2)-divided, ± fibrillose in the upper 1/3–1/2, occasionally throughout, on the outer surface with membrane pleats and sometimes a few, scattered, rounded membrane gaps, on the inner surface largely resorbed or sometimes with 1 to several large, rounded membrane gaps or pores in commissural rows. Branches in fascicles of 4 (2 spreading). Branch cortex in 1 layer, without fibrils, the retort cells with rather conspicuous necks. Branch leaves crowded, not noticeably ranked, sometimes slightly secund, broadly oblong-lanceolate, narrowly involute-pointed, toothed across the narrow

apex, bordered by a few rows of linear cells; hyaline cells decidedly convex on the outer surface, only slightly so on the inner, on the outer surface with pores numerous, at the leaf tip very small, elliptic, strongly ringed, becoming larger and less ringed below, in ends and corners (often in 3's at adjacent corners) and occasionally along the commissures, on the inner surface with pores none or few, occasionally with 1–2 rather large, rounded gaps (of nearly cell width) in ends and corners toward the leaf tip; green cells in section broadly triangular, with the base exposed on the inner surface. Apparently dioicous. Spores ca. 22 μm, smooth or nearly so. – Fig. O.

On wet, shaded banks and cliffs at 6000 to 10,000 ft. altitude. Eastern and southern Mexico–Chiapas (Liquidambar; Montebello; Mapastepec); Oaxaca (Sierra Juárez; Zacatepec; Llano de las Flores; Chinantla); Puebla (Honey Station). Guatemala, Costa Rica, and northern South America.

Having the compact appearance of *S. capillifolium* (Ehrh.) Hedw. (a common species of circumpolar range), *S. sparsum* has cells of the stem cortex uniformly porose. The stem leaves are involute-pointed, and their hyaline cells, more or less fibrillose, are rather consistently 1–2-divided and have membrane pleats on the outer surface. The branch leaves are crowded-imbricate and rather slenderly involute-acuminate. The green cells of the branch leaves are broadly exposed on the inner surface; and the hyaline cells, on their outer surfaces, have numerous, rather small, elliptic, strongly ringed pores.

11. **Sphagnum meridense** (Hampe) C. M. (syn. *S. platycladum* C. M.) – Plants tall and loosely tufted in very soft, deep mounds, pale whitish-green to pink. Wood cylinder of stem yellowish to pinkish; cortical cells in 2–3 layers, rectangular, thin-walled, without fibrils or pores or, more frequently, with some cells porose at their upper ends. Stem leaves 1.5–2 mm long, oblong-ovate or oblong-triangular, concave and broadly acute at

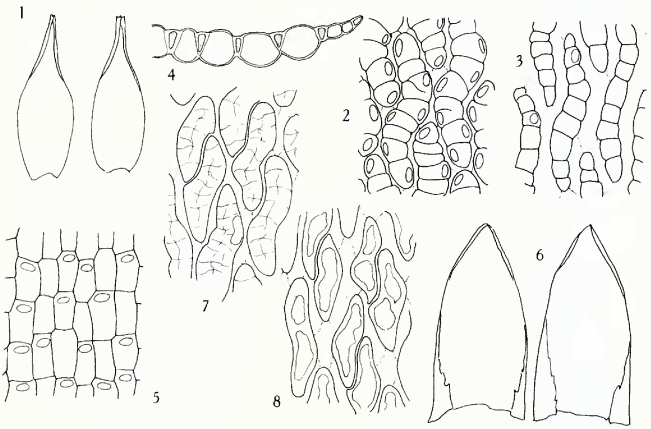

FIG. O. *Sphagnum sparsum.* 1. Branch leaves, X 27. 2. Upper median cells of branch leaves, outer surface, X 400. 3. Upper median cells of branch leaves, inner surface, X 400. 4. Cross-section of branch leaf, X 400. 5. Stem cortex, X 400. 6. Stem leaves, X 27. 7. Upper cells of stem leaf, outer surface, X 400. 8. Upper cells of stem leaf, inner surface, X 400.

the apex, the border rather strong above, not or slightly broadened at base; hyaline cells not or rarely 1-divided above, sometimes divided toward the base, usually without fibrils and pores but exceedingly variable, on the outer surface often with membrane pleats but no pores or membrane gaps, sometimes ± fibrillose near the apex, on the inner surface without pores or gaps, or sometimes with 1–5 irregularly rounded membrane gaps (often as broad as the cells) or 6–12 large, rounded or rounded-elliptic, unringed commissural pores. Branches in fascicles of 5–6 (2–3 spreading). Branch cortex in 1 layer, without fibrils, the retort cells with only slightly protruding necks. Branch leaves soft, rather widely spaced, loosely erect-spreading, deeply but broadly concave, 1.3–2 mm long, broadly oblong-ovate or elliptic, gradually narrowed to a short, involute-concave tip (more concave, narrower, and more abruptly short-pointed when moist), toothed across a narrowly truncate apex, bordered by 1–3 rows of linear cells (with no resorption furrow); hyaline cells slightly convex on the inner surface, somewhat more so on the outer,

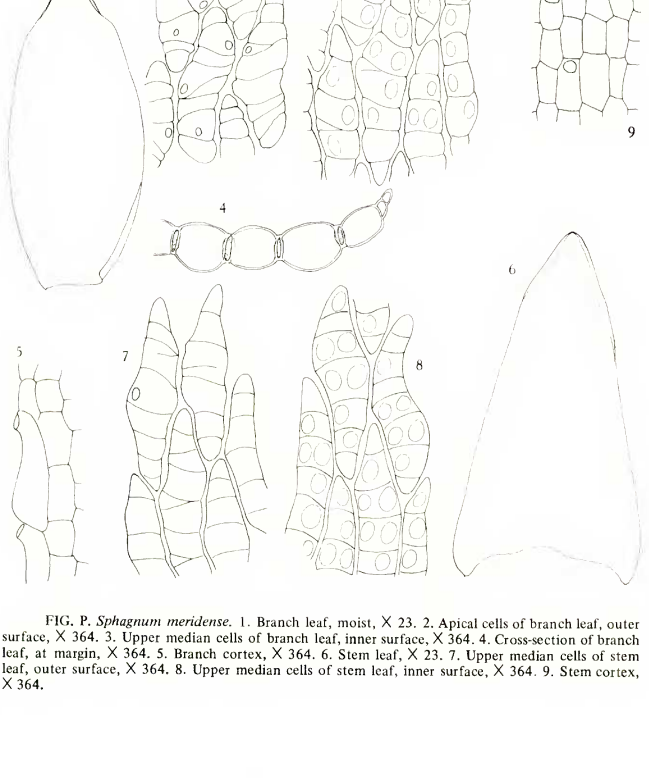

FIG. P. *Sphagnum meridense*. 1. Branch leaf, moist, X 23. 2. Apical cells of branch leaf, outer surface, X 364. 3. Upper median cells of branch leaf, inner surface, X 364. 4. Cross-section of branch leaf, at margin, X 364. 5. Branch cortex, X 364. 6. Stem leaf, X 23. 7. Upper median cells of stem leaf, outer surface, X 364. 8. Upper median cells of stem leaf, inner surface, X 364. 9. Stem cortex, X 364.

on the outer surface often with membrane pleats near the leaf apex, pores usually lacking except for a few, very small and inconspicuous, rounded to elliptic, ringed pores near the leaf tip, at ends and corners, sometimes in the middle (3–6, rarely 8, or sometimes none), very rarely with a scattered few larger, elliptic corner pores in median and lower portions of the leaf, on the inner surface with pores usually numerous, 4–8 per cell (rarely only 1–3), rather large, rounded, distinct but not ringed, at ends and corners, sometimes also at the commissures; green cells in section lenticular to fusiform, equally exposed because of thickened ends. Dioicous. Spores 20–24 μm, very minutely papillose. – Fig. P.

On moist banks of trails, sometimes on rock faces in forests at altitudes of 5500 to 10,000 ft. Mexico–Chiapas (Liquidambar; Mapastepec; Montebello); Guerrero (Cerro Teotepec); Hidalgo (Apulco; Tenango de Doria); Oaxaca (Sierra Juárez; Llano de las Flores; La Esperanza; Cerro de Fentila); Puebla (Atoluca; Cuetzalen; Honey Station; Teziutlán); Veracruz (between Teziutlán and Tlapacoyán). Guatemala and Costa Rica; northern South America; Greater Antilles.

Sphagnum meridense is a beautiful moss, very soft and pale, often attractively pink. The softness results from wide-spaced and erect-spreading leaves. The branch leaves are broadly concave, more or less elliptic, and shortly involute-pointed. The hyaline cells of the branch leaves are mainly without pores on the outer surface, except for a few, very small, and very inconspicuous ones in a few uppermost cells; on the inner surface the pores are numerous, rounded, and relatively large. The stem leaves show a remarkable variation. Usually both pores and fibrils are lacking, but sometimes fibrils are present, especially on the inner surface where they may be associated with membrane gaps or few to numerous large, rounded to elliptic commissural pores (as shown in Fig. P, 8). The cortex of the stem is sometimes lacking in pores, but more commonly some, many, or perhaps even all of the cells are porose.

The species is remarkably similar in appearance and structural detail to *S. limbatum* Mitt. (syn. *S. antillarum* Besch.), a species not known from Mexico but widespread elsewhere in tropical America. *S. limbatum* has cells of the stem cortex mostly porose; stem leaves with numerous ringed, elliptic commissural pores on the outer surface of hyaline cells and rounded commissural gaps on the inner surface; branch leaves with numerous narrowly elliptic corner pores on the outer surface of hyaline cells–throughout the leaves–and rather noticeably in 2's or 3's at adjacent corners; and green cells narrowly truncate-elliptic or lenticular with equal exposure on both surfaces. The elliptic pores on the outer surface of branch leaves (and throughout their length) and the pores or pore-like gaps on both surfaces of the stem leaves provide the best distinctions from *S. meridense.* The crowded, imbricate, and narrowly involute branch leaves, coupled with the triangular sectional view of its green cells, serve to separate *S. sparsum* from both *S. limbatum* and *S. meridense.*

In Guatemala, *Sphagnum meridense* is used in Christmas decoration. It is called *colchon de niño,* owing to a belief that the Christ Child was bedded in that soft and colorful moss. (It is also called *ush*–a name suitably descriptive of spongy softness regardless of the language!)

Andrews' report of *S. meridense* from Florida (in the *North American Flora,* 1913, without locality data) appears to be based on a specimen from Austin's herbarium (NY) of uncertain origin. It is labeled "*S. acutifolium* nr. *tenerum,* Closter, New Jersey" [Austin's home], but it has a penciled query after the locality which Andrews assumed Austin himself had made. Andrews (Ann. Bryol. 6: 4. 1933; Bryol. 61: 275. 1958) recognized the species as a tropical one, having nothing to do with *S. tenerum* Sull. & Lesq. *ex* Sull. or *S. acutifolium* "var." *tenerum* Aust. *ex* Warnst. (Hedwigia 29: 194. 1890, *nom. nud. in syn.*), a name that resulted from a misinterpretation of Austin's determination (as near, not var. *tenerum*). Andrews assumed that the specimen came from some place farther south, perhaps Florida where Austin had collected, but since the species is montane in its distribution in tropical America, it is not likely to occur in Florida's lowlands. Other

more recent records of *S. meridense* from Florida are based on misdeterminations of *S. magellanicum* and *S. tenerum.*

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